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US Army Research Laboratory

M2 .50-cal. Multishot Capabilities at the US Army Research Laboratory

by Todd Brinkman

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Weapons and Materials Research Directorate, ARL

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14. ABSTRACT
This technical note shows the capabilities and method required to fire dual single-shot Mann barrels in a multishot scenario. This note will also discuss the equipment required to perform a multishot task.

15. SUBJECT TERMS
solenoid, barrel, small arms, mount, time delay

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- Rick Rapposelli, gunner (WMRD, Bowhead contractor)

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1. Introduction

In small arms experimentation it is desirable to conduct experiments using an actual fielded threat weapon system whenever possible. On occasion, however, this may not be possible, and a surrogate must be substituted.

In these experiments a platform was designed to simulate the 2-round burst of the M2 .50-caliber Browning machine gun (BMG). The 2-round-burst cyclic rate was achieved by using 2 Mann barrels, fired off of a standard Frankford Arsenal rest in conjunction with a time delay generator.

2. Procedure

In small arms experimentation a Mann barrel is often used as a surrogate for a small arms weapons system. When used in conjunction with a breech cap, firing solenoid, and firing box, the Mann barrel will deliver the same results as an actual small arms weapon in single shot mode. The requirement for this experiment was to simulate a 2-round burst at a rate of 0.12 s between rounds. Because of the time needed to reload, this firing rate was not achievable with a single Mann barrel. As a result, a platform was developed using 2 Mann barrels to achieve the 2-round burst rate.

A set of custom 2-part mounts was designed that would accept 2 Mann barrels and also bolt into a Frankford Arsenal mount. Also, a firing unit was fabricated that would provide the same cyclic rate of fire for 2 shots.

2.1 Mounts

While the mounts were being designed, consideration was taken for the space allowance between not only the barrels but also the firing solenoids. Ease of operation, such as installation and removal of the barrels and solenoids, loading of the cartridges, and cleaning were also factors in its design. The design also had to be robust enough to handle the effects of multiple shots. Based on experience, it was determined that 2-inch-thick aluminum, machined from billet stock, should be able to withstand the rigors of the firing sequence (Fig. 1). The cutouts on the mount were designed large enough to accept sizes up to a standard Mann barrel and also a barrel with a smaller profile. In this case, the space between the barrel and inside diameter of the mounts was sleeved with thin strips of lead to ensure a secure fit. The mounts were bolted to the Frankford Arsenal rest with all-thread, washers, and bolts (Fig. 2).

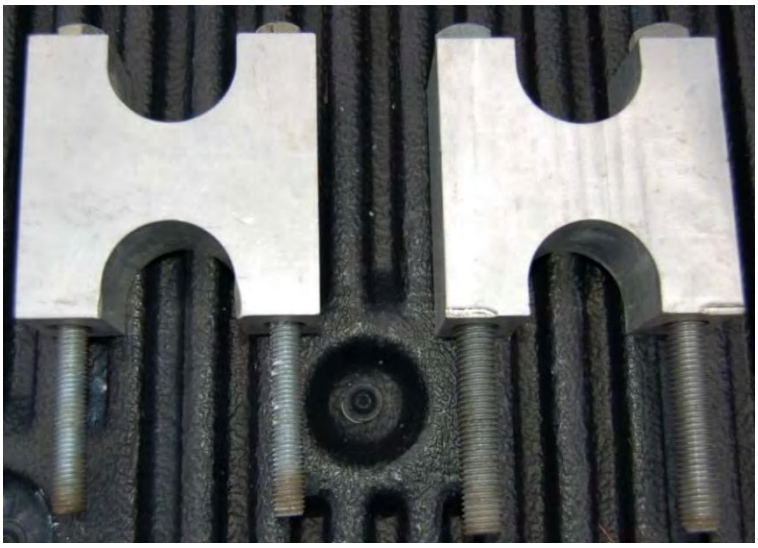

Fig. 1 The 2-inch-thick aluminum mounts

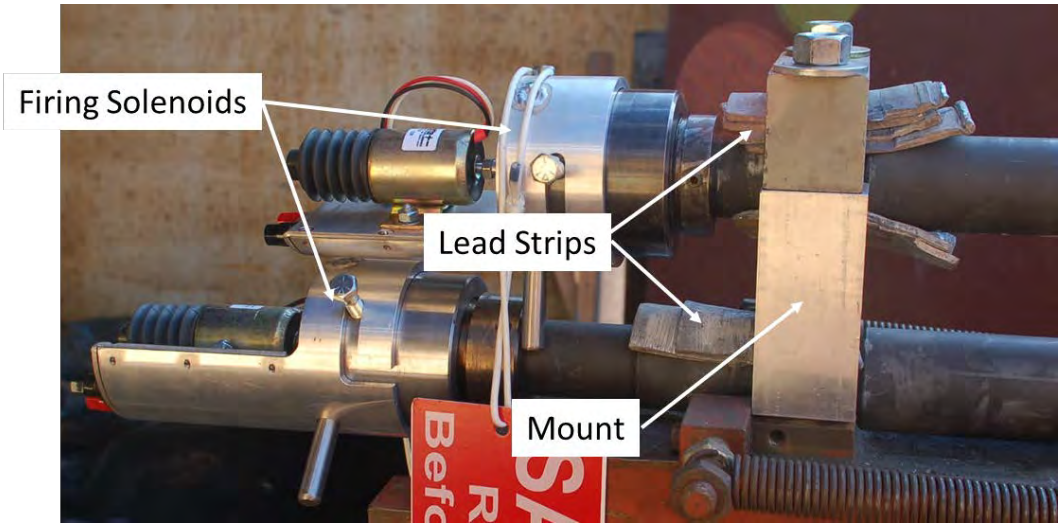

Fig. 2 The 2-Mann-barrel setup

2.2 Firing Unit

A custom-made firing unit that was used to provide the required power to the firing solenoid is shown in Fig. 3. It is a 115-V alternating current (AC) power supply that converts the supplied energy to direct current (DC). Seventy volts of DC is the minimum power required to sufficiently drive the shaft in the solenoid for successful functioning of the round(s). A short DC-to-BNC (Bayonnet Neill-Concelman) adapter (Fig. 4) was made to deliver the required voltage from the firing box to the firing line; an Amphenol connector is used at the box end of the adapter. This adapter hooked directly to the firing line which, in turn, connected to the firing solenoid.

Fig. 3 Firing unit

Fig. 4 Amphenol-to-BNC adapter cable

2.3 Sequencer/Time Delay Generator

The M2 BMG fires at a rate of 0.12 s between rounds. This delay is based on an assumed cyclic rate of 450 to 550 rounds/min when using M33 ball ammunition.[1] To replicate this rate of fire, a sequencer (Fig. 5), or time delay generator, was implemented in the setup. These generators are used in many types of experiments, controls, and processes where electronic timing of a single event or multiple events to a common timing reference is needed. The delay generator may initiate a sequence of events or be triggered by an event. What differentiates it from ordinary electronic timing is the synchronicity of its outputs to each other and to the initiating event.

Fig. 5 Sequencer

2.4 Solenoid

The firing solenoid used for this experiment is shown in Fig 6. A complete description of the solenoid can be found in the US Army Research Laboratory (ARL) technical note titled *Implementation of Improved Firing Solenoids for Experimental Gun Tubes*.[2]

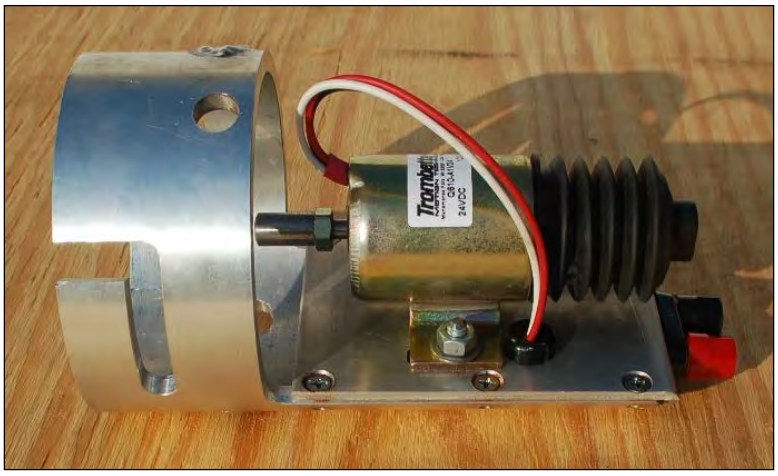

Fig. 6 Firing solenoid

3. Discussion

The 2-Mann-barrel setup shown in Fig. 7 was most recently used on a .50-cal. Fuel Fire program for ARL at Aberdeen Proving Ground, MD. With the aforementioned components in place for the experiment, the required firing rate of 0.12 s between rounds was achieved, giving researchers technical insight into a multishot scenario against a surrogate fuel tank. Timing sequences were verified through the use of North American Camera high-speed imagery.

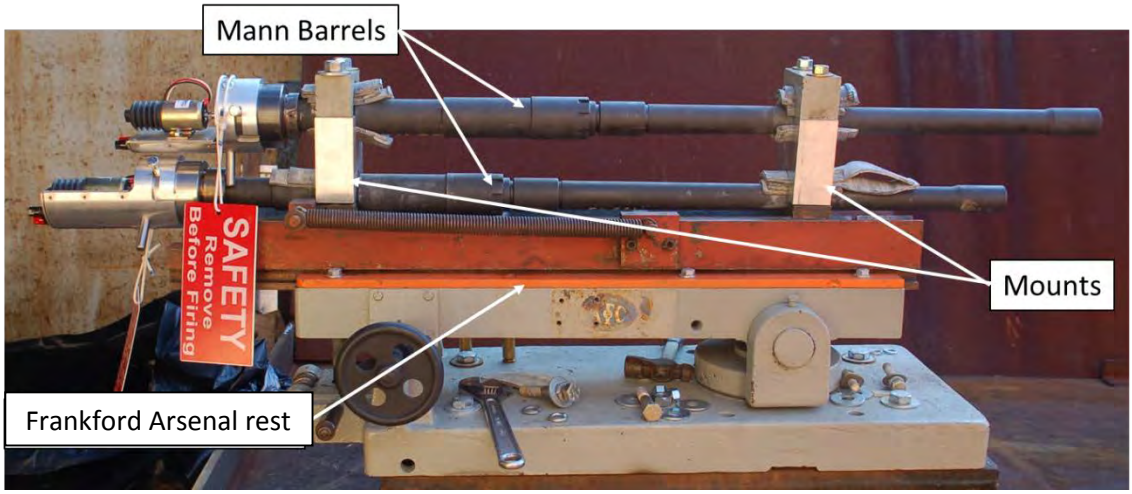

Fig. 7 The 2-Mann-barrel setup mounted to a Frankford Arsenal rest

A description of .50-cal. multishot capabilities, as well as the setup, has been detailed in this technical note. They have proven to be an effective combination for multihit scenarios when an original weapon is not available for experimentation.

It is believed that this setup can be used to achieve 2-shot cyclic rates of fire on a wide array of small arms weaponry within the military arsenal.

4. References

1. Army Study Guide. M2 equipment information; nd [accessed 2015 Aug 24]. http://www.armystudyguide.com/content/army_board_study_guide_topics/m2/m2-equipment-information.shtml.

2. Brinkman T. Implementation of improved firing solenoids for experimental gun tubes. Aberdeen Proving Ground (MD): Army Research Laboratory (US); 2014 Oct. Report No.: ARL-TN-0639.

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